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Are the Cognitive Processes Underlying Practical Intelligence Redundant with Those Underlying Traditional Intelligence

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ARE THE COGNITIVE PROCESSES UNDERLYING PRACTICAL INTELLIGENCE
REDUNDANT WITH THOSE UNDERLYING TRADITIONAL INTELLIGENCE?

A Thesis
Presented to
the Faculty of the Department of Psychology
Western Kentucky University
Bowling Green, Kentucky

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts

by
Shari T. Rauscher

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ARE THE COGNITIVE PROCESSES UNDERLYING PRACTICAL INTELLIGENCE
REDUNDANT WITH THOSE UNDERLYING TRADITIONAL INTELLIGENCE?

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The Cognitive Processes Underlying Practical Intelligence

The field of Industrial/Organizational Psychology is often focused upon predicting job performance. One of the most commonly used tools for predicting job performance is the general intelligence test. Many researchers believe general intelligence test scores are the best predictors of job performance (Barrett & Depinet, 1991; Herrnstein & Murray, 1994; Jensen, 1993; Ree & Earles, 1992, 1993; Schmidt & Hunter, 1977, 1981, 1993). According to Jensen (1993), “there is no longer any question that g is a large component of virtually every measure that validly predicts training outcomes and proficiency on the job in a wide variety of occupations” (Jensen, 1993, p.9).

Schmidt and Hunter (1981) stated that intelligence tests validly predict both job performance and job training in every job in every setting. They assert that opting to use other less valid predictors of job performance, such as an interview, will result in decreased productivity both for individual organizations as well as for the economy. Hunter (1986) reviewed 515 validation studies the U.S. Employment Service conducted on the General Aptitude Test Battery (GATB). He reported validity coefficients that ranged from .23 to .58, and discovered no job for which intelligence was not a valid predictor of performance. Barrett and Depinet (1991) reviewed several studies on the relationship between cognitive ability tests and job performance and concluded that intelligence test scores were related to both job performance and job success. Hunter and Hunter (1984) conducted a meta-analysis of 425 studies that used the GATB to predict

job mastery/proficiency criteria. Results showed that the average validity coefficient was .45, with a range of .23 to .58. They also found an average validity coefficient of .53 between scores on the GATB and job performance. Hunter (1985) also analyzed the Armed Forces Qualification Test (AFQT) scores for 472,539 military personnel and found a correlation of .62 between AFQT scores and success in training.

Finally, Ree, Earles, and Teachout (1994) compared the predictability of *g* versus specific abilities within a given job, based on a sample of 1,036 U. S. Air Force enlistees. The enlistees' scores on the Armed Services Vocational Aptitude Battery (ASVAB) were factor analyzed to produce *g* and nine specific abilities. The criteria measures consisted of a hands-on performance test, an interview work sample test, and the combination of the two. Eight different jobs were used in the analyses. The researchers found that *g* was the best predictor of the job performance criteria, and that the specific abilities added only a small amount to the prediction.

Since the turn of the century, researchers have sought to uncover the latent structure of intelligence. Spearman (1927) analyzed performance on intelligence tests in order to address that question. He asserted that all of the tests evaluating intellectual ability do so because they all assess the same trait. Numerous factor analyses on intelligence tests since Spearman have all produced the same result: one factor accounts for the majority of the variance. Spearman labeled it a general factor of intelligence, or *g* (Herrnstein & Murray, 1994; Jensen, 1992; Spearman, 1927). This general factor soon became synonymous with words such as intelligence, cognitive ability, academic ability and IQ. One single component was found to capture the nature of intelligence. Intelligence in this view is not defined as the capability to learn and apply knowledge, but

as "...a measure of a person's capacity for complex mental work" (Herrnstein & Murray, 1994, p. 4).

However, not all researchers believe that a general factor of intelligence exists or is as valid a predictor of job performance as its proponents claim it to be. One of g's staunchest opponents has been David McClelland. McClelland (1973) presented several objections to the use of g as a predictor and proposed arguments disputing its ability to predict validly and accurately. He asserted that the relationship between cognitive ability tests scores and job performance may be an "artifact." He claimed the moderator of this relationship is one of social class, because the opportunities afforded those of higher classes can help contribute to greater success in school and on the job. He recommended, instead, that employers should use different tests that are better predictors of job performance and job success. He advocated using a test that more closely mirrors real-life situations. Intelligence tests, according to McClelland, give individuals a very clearly defined problem in a very structured atmosphere and present defined choices from which the individual can choose. Because performance on the job requires quick, spontaneous responses to very ambiguous stimuli, he feels tests predicting job performance should tap into that. The test should present problems with several right answers, with one answer better than the others. He also advocated using predictor tests on which an individual could display improved performance, as he or she accumulates more experience and ability on the job.

Another researcher who advocated predicting job performance with measures other than cognitive ability tests is Robert Sternberg. Sternberg (1995) believed much of what constitutes intelligence is not measured by intelligence tests. Sternberg (1995,

1997b) believed traditional measures of intelligence, or *g*, may be a good predictor of successful job performance across different jobs, but may not be as good a predictor within jobs. He cites three reasons for this belief. First, the range of IQs across jobs is larger than the range of IQs within jobs. The restriction of range that results in a within-job comparison lowers the correlation. Second, factors other than IQ may make more of a difference in actual job performance. For instance, regardless of whether an individual is a professor or a surgeon, successful job performance depends not only upon general intelligence but also upon a specialized knowledge of the field. Lastly, some theorists within the field of intelligence advance the belief that there is more than one type of IQ. For example, Gardner (1983) posited a view of multiple intelligences that goes beyond what is traditionally meant by IQ.

Sternberg (1984, 1991, 1995, 1997a) developed a triarchic theory of intelligence to better capture what he views is the true nature of intelligence. According to this theory, intelligence is not one single thing; it cannot be fully captured by *g* or IQ. Sternberg does not argue that there may be a general factor for intelligence, but that *g* is not as general as some would contend. The idea behind the triarchic theory of intelligence is that using one factor to describe intelligence is a narrow view of the construct and captures only one facet of intelligence.

Sternberg asserts instead that there are three different types of intelligence.

Analytical intelligence is similar to traditional psychometric concepts of intelligence.

This type of intelligence involves problem solving and information-processing. Creative intelligence involves insight and can be defined as "...the synthetic ability to see problems in new ways and to escape the bounds of conventional thinking" (Sternberg,

1997, p. 488). The last type of intelligence as identified by the triarchic theory is practical intelligence. This type of intelligence "...involves the ability to grasp, understand, and solve real life problems in...everyday...life" (Miele, 1995, p. 72). This intelligence is the kind that Sternberg feels is the best predictor of success in real-world situations and is the most useful aspect in predicting job success.

The triarchic theory also contends that intelligent thought is deliberate, and thus guided and organized towards specific objectives: adapting, shaping, and selecting one's environment. Adaptation "...consists of trying to achieve a good fit between oneself and one's environment" by changing oneself (Sternberg, 1984, p. 272). This goal is the one that most intelligent thought is aimed toward and is captured by most traditional views of intelligence (Sternberg, 1984, 1991). Shaping is utilized when one is unable to adapt to one's environment successfully. Efforts are made instead to "reshape" the environment in order to achieve a greater fit. This means that intelligent behavior is not universal, since what may constitute intelligence in one setting or environment may not generalize to another setting or environment (Sternberg, 1984). Lastly, selection is undertaken when attempts to adapt or shape one's environment fail. Selection involves choosing a different environment in which one can obtain a better fit.

There are reasons to believe job performance can be predicted by methods other than IQ tests. Much of what an individual faces in his or her everyday work life is not tapped by traditional intelligence tests and is not related to the typical problems encountered on IQ tests (McClelland, 1973; Sternberg, 1995; Sternberg, Wagner, Williams, & Horvath, 1995; Wagner & Sternberg, 1985). Sternberg (1995) described the state of testing:

Conventional test problems are formulated by others, are well-defined, have all information provided from the beginning, have only one supposedly correct answer, usually have only one method of obtaining the correct answer, are disembedded from ordinary experience, and are of little or no intrinsic interest. Problems on the job, in contrast, emphasize recognition and formulation of just what the problems are, are usually ill-defined, require information seeking, have multiple “correct” solutions, have multiple methods of obtaining these solutions, require use of prior experience, and are highly motivating (pp. 320-321).

These descriptions delineate the differences between what is thought of as academic intelligence and practical intelligence, or common sense. The definition of academic intelligence is captured by the above explanation of conventional tests. Traditional intelligence tests tap into academic intelligence. These tests of mental ability are testing general mental ability, or *g*. Individuals with high academic intelligence possess “formal academic knowledge” which is the knowledge tested by intelligence tests (Sternberg, et al., 1995).

There is a recurrent observation that runs counter to the belief that IQ predicts job performance. Frequently, one will encounter individuals with successful educational backgrounds, yet who are unsuccessful in their careers. On the other hand, there are also individuals who did not do well academically but are very successful in their occupations. How can one account for such contradictory phenomena? Several lines of research point to the belief that the intellectual abilities required in academia and nonacademia are different (Sternberg, 1996; Sternberg, et al., 1995; Sternberg & Wagner, 1993; Torff &

Sternberg, 1998). The mental competencies needed to succeed in school can be quite different from those required to succeed in the workplace for many jobs.

Sternberg argued that tests of academic intelligence are not as useful for predicting performance in real-world pursuits as is widely believed. Much of what an individual encounters in the workplace is unrelated to the formal knowledge acquired in school. He believes attempts to predict job performance should center on testing the second half of the above description: that of problems faced on the job. Practical intelligence is precisely the aspect of intelligence he purported more accurately addresses the nature of everyday work issues.

Recall McClelland's (1973) suggestion for improving prediction of job performance. He advocated using tests that more closely reflected real-life situations. Practical intelligence tests are one of those measures. Practical intelligence is defined as "knowledge that is not explicitly taught and often is not even verbalized, but that is necessary for successfully adapting to the environment" (Pulakos, Schmitt, & Chan, 1996). Traditional intelligence tests, in Sternberg's view, are capable of tapping into what people have the ability to do. Practical intelligence tests, on the other hand, are better able to predict what people actually do (Miele, 1995). Possessing the knowledge to do something and actually doing it well are two different concepts (McClelland, 1993).

Individuals with high practical intelligence utilize "tacit knowledge" (Sternberg, et al., 1995). Tacit knowledge is "knowledge that usually is not openly expressed or stated" (Wagner & Sternberg, 1985, p. 438). It is knowledge that is generally not formally taught or expressed, and often is guarded since its acquisition is instrumental to success in many real-world situations (Sternberg, 1985, 1995, 1997a). Three

characteristic aspects of tacit knowledge have been identified (Sternberg, et al., 1995; Sternberg, 1997a). First, tacit knowledge is procedural, or directly related to action. Tacit knowledge is always linked to a specific use or uses. Second, tacit knowledge is pertinent to achieving valuable goals. When an individual is presented with knowledge that is relevant to accomplishing a highly valuable goal, that knowledge is perceived as extremely useful. Third, tacit knowledge is procured independently, in the absence of any immediate assistance from others. It is knowledge that “is unspoken, underemphasized, and typically poorly conveyed relative to its importance for practical success” (Sternberg, 1997a, p. 484).

Tacit knowledge can be divided into three different categories (Sternberg, 1995; Wagner & Sternberg, 1985). One category is tacit knowledge about managing self, which is knowledge about how to manage, motivate or organize oneself in order to increase productivity. A second category, managing others, pertains to knowledge about how to manage and relate with subordinates, superiors and peers. The last category, managing tasks, refers to knowledge about how to effectively complete specific tasks related to work.

Sternberg (1995, 1997a) asserted that one of the basic tenets of practical intelligence is that it is more useful in real-world endeavors and embodies the abilities necessary to succeed outside of the academic environment. Several studies have been conducted to further investigate what evidence exists to support this claim. Specifically, these studies address the question of whether practical intelligence, as measured by tacit knowledge inventories, really predicts accomplishments and achievements in a managerial setting.

Wagner and Sternberg (1985) conducted a study investigating tacit knowledge and its role in practical intelligence. In one part of the study, the group consisted of students and faculty. Another part of the study used a group that consisted of undergraduates, business graduate students and business managers. Each group took a tacit knowledge test. Both experiments showed a differentiation between subgroups in their responses. Namely, tacit knowledge items differentiated individuals with more experience and training from those with less experience in both psychology and business management. These results suggest that measures of tacit knowledge test knowledge obtained partly through training and experience in a given field. Thus lending support to the significance of tacit knowledge “to intellectual competence in real-world pursuits” (p. 443).

Also, for both the business and the psychology groups, performance on the tacit knowledge test showed high correlations with criterion measures for most of the subgroups. For instance, the total score on the tacit knowledge test for psychology faculty was related to number of publications (.33, $p < .05$) and amount of time conducting research (.39, $p < .01$). Tacit knowledge scores showed negative correlations with criteria such as time spent completing administrative tasks (-.41, $p < .01$). Generally, tacit knowledge positively correlated with criteria related to research and negatively correlated with criteria outside the research realm. These results suggest that tacit knowledge tests have the ability to measure aspects that are pertinent to performance in the real world/actual job. The results of the correlations for psychology graduate students were similar. Tacit knowledge scores had positive correlations with criteria such as number of publications (.31, $p < .01$) and level of school (.52, $p < .01$).

Within the business group, scores on the tacit knowledge test showed high positive correlations with criteria such as salary (.46, $p < .01$) and whether the manager worked for a Fortune 500 company (.34, $p < .05$). The correlations were not significant for business graduate students. Again, these results suggest that performance on tacit knowledge tests is highly related to performance required in actual jobs.

Wagner and Sternberg (1985) have found even higher correlations between achievement and accomplishments in specific areas of managerial performance and level of tacit knowledge using 29 bank managers. For instance, tacit knowledge was correlated with average percentage of salary increase (.48, $p < .05$), execution of the bank's policy and procedures (.39, $p < .05$), and the production of new business for the bank (.56, $p < .05$).

The Present Study

A concern that has been raised about tacit knowledge tests centers around whether it is simply another kind of measure of *g*. In other words, do tacit knowledge tests just tap into the same kind of information traditional intelligence tests do, or are they measuring information outside the realm of general intelligence? Eddy (as cited in Sternberg, et al., 1995) gave 631 Air Force Recruits both a tacit knowledge test designed for managers and the Armed Services Vocational Aptitude Battery (ASVAB). Correlations between the two tests ranged from .06 to -.15, with a median correlation of -.07. These results show that tacit knowledge tests do measure something that is different from what traditional intelligence tests measure. Similar results have been shown with a sample of 20 Yale undergraduates (-.04, $p > .05$) (Wagner & Sternberg, 1985) and 22 Yale undergraduates (.16, $p > .05$) (Wagner & Sternberg, 1985). Because these groups represent a restricted range of ability, the conclusions drawn from those studies may be somewhat limited.

Sternberg credits findings such as the above as evidence that tacit knowledge is not just another way of assessing *g*. He asserts that tacit knowledge tests tap a separate kind of intelligence, which he calls practical intelligence. It is important to fully understand if these are indeed two different kinds of intelligences. One way to differentiate is to discover if individuals high in general intelligence utilize different cognitive processes to solve problems than do those high in practical intelligence, or if the cognitive processes involved in problem solution is the same for each kind of

intelligence. The results of such an investigation have important implications for Industrial/Organizational psychology.

This researcher investigated exactly which cognitive processes individuals employ when they are engaged in traditional intelligence test tasks and tacit knowledge tasks. Given the research base indicating low correlations between measures of the two constructs, we expect to find little convergence of cognitive processes between the two tests. Classification of the cognitive processes will employ Dunnette and Fleishman's (1982) taxonomy. Their taxonomy was actually a compilation of several cognitive processes identified by Dunnette (as cited in Dunnette & Fleishman, 1982), Ekstrom (as cited in Dunnette & Fleishman, 1982), and Ekstrom, French, and Harmon (as cited in Dunnette & Fleishman, 1982). The 12 processes are as follows:

1. Flexibility and speed of closure: the ability to "hold in mind" a particular visual percept and find it embedded in distracting material; and the ability to "take in" a perceptual field as a whole, to fill in unseen portions with likely material and thus to coalesce somewhat disparate parts into a visual percept.
2. Fluency: a combination of four different fluencies; associative, producing words from a restricted area of meaning; expressional, supply proper verbal expressions for ideas already stated or finding a suitable expression that would fit a given semantic frame of reference; ideational fluency, quickly producing ideas and exemplars of an idea about a stated condition or object; word fluency, producing isolated words that contain one or more structural, essentially phonetic, restrictions without reference to the meaning of the words; figural, the ability to

produce a response quickly by drawing a number of examples, elaborations, or restructurings based on a given visual or descriptive stimulus.

3. Inductive reasoning: ability in forming and testing hypotheses directed at finding a relationship among elements and applying the principle to identifying and element fitting the relationship.
4. Associative (rote) memory: ability to remember bits of unrelated material.
5. Span memory: ability to recall perfectly for immediate reproduction a series of items after only one presentation of the series.
6. Number facility: ability to manipulate numbers in arithmetical operations rapidly; facility in performing elementary arithmetical operations (typically under speeded conditions).
7. Perceptual speed: speed in finding figures, making comparisons, and carrying out other very simple tasks involving visual perception.
8. Syllogistic (deductive) reasoning: ability to reason from stated premises to their necessary conclusion; ability in formal reasoning from stated premises to rule out nonpermissible combinations and thus to arrive at necessary conclusions.
9. Spatial orientation and visualization: ability to perceive spatial patterns or to maintain orientation with respect to objects in space and the ability to manipulate or transform the image of spatial patterns into other visual arrangements.
10. Verbal comprehension: knowledge of words and their meaning as well as the application in understanding connected discourse.

11. Verbal closure: the ability to solve problems requiring the identification of words, when some of the letters are missing, disarranged, or mixed with other letters.

12. Visual memory: the ability to remember the configuration, location, and orientation of figural material (Dunnette & Fleishman, 1982, p. 68-69).

This study will address two hypotheses:

Hypothesis 1: Subjects use different processes when solving practical intelligence tasks than when solving traditional cognitive ability tasks.

Hypothesis 2: High scoring subjects use different cognitive processes on both the practical and cognitive ability tests than do low scoring subjects.

Method

Participants

Sixty-three business school students from a large southeastern university volunteered to take part in this study. Each participant was paid eight dollars for his or her participation. One participant's data was excluded from the analysis because he did not verbally record how he answered the test questions. Another participant's data was omitted from the final analysis because her verbal protocol was incomprehensible due to language problems.

Information was collected on the participant's gender, class (graduate or undergraduate), and status (traditional or nontraditional student). A concern is that the use of both graduate and undergraduate students would confound the results. One would expect graduate students to have more knowledge and experience to draw from, thus rendering them more "practically intelligent" than their undergraduate counterparts. Additionally, undergraduates were asked to indicate if they had plans to pursue an MBA.

Of the 61 participants used in the analysis, there were 30 males and 29 females, 36 traditional and 23 nontraditional students, and 22 graduate and 37 undergraduate students. Two participants failed to provide any demographic information. Of the 37 undergraduates, 17 indicated an intention to pursue an MBA, 18 indicated no such intention, and five were undecided. Participants were randomly assigned into groups.

Apparatus

The group of participants assigned to the traditional intelligence condition completed a shortened form of the Raven Advanced Progressive Matrices test (APM; Arthur & Day, 1994), a traditional intelligence test (see Appendix A for a sample problem). The group of participants assigned to the traditional intelligence condition completed the Tacit Knowledge Inventory for Managers (TKIM; Wagner & Sternberg, 1991), a practical intelligence test (see Appendix B for a sample problem). Participants recorded their answers to each test onto an answer sheet with a pencil. All participants used tape recorders to verbally record their thought processes as they solved each problem.

Procedure

Each participant took the test alone in an empty classroom. The experimenters presented one or two sample problems and worked through them with the participant, in order to ensure comprehension of the task. Each participant was instructed to think out loud as he or she solved each problem, and not to worry about sounding redundant or foolish.

Participants' thought processes were classified and coded according to the taxonomy of cognitive processes outlined previously. In coding the protocols, however, it was discovered that some responses could not adequately be coded by simply utilizing the twelve processes listed in the Dunnette and Fleishman (1982) taxonomy. For instance, when some participants attempted to verbalize their thought processes on some of the Raven APM problems, they described adding or subtracting figures in order to come up with the solution. This process did not appear to be completely captured by any of the

twelve listed processes, so the code “Figural Addition/Subtraction” was added as an additional process to be used in coding. Similarly, on some of the TKIM problems, participants qualified their answers as being consistent with behavior they had performed before or seen someone else perform. This cognitive process was also one that did not exist in the original taxonomy, so the code “Experience” was included. Lastly, the code “No Reason Given” was added because some participants failed to provide a reason for answering the way they did, or simply restated the problem in their explanation. In all, fifteen processes were used in the coding and classification of participants’ thought processes. See Appendices C and D for examples of a coded TKIM and Raven APM test.

In order to establish interrater reliability, six tapes were randomly selected and then transcribed. Two raters were given a test to code without prior knowledge of which test they were coding. Due to the nature of the two tests, however, it was an easy task to identify which test was being coded once the participant began figuring out the problem and verbalizing his or her thought processes. The transcriptions were coded independently. The interrater-reliability coefficient was $r = .847$ ($p < .01$).

After each participant’s cognitive processes were coded, a total sum for each process was calculated in order to produce a frequency for each response. The frequencies for each process were then added up for each participant, resulting in a total frequency response across all cognitive processes. A percentage was then calculated for each cognitive process by dividing the individual frequency for each process by the total frequency for the participant. This procedure was followed to eliminate arbitrary differences between the tests and subjects in terms of the raw number of processes involved.

The TKIM was scored according to a method given in the test manual (Wagner & Sternberg, 1991). The answer key was computed using 27 high level expert managers at a large manufacturing plant. Average scores across the 27 experts for each question served as the correct answers. Student responses were scored by a comparison with each correct answer. The absolute value of the difference was computed for each question and then summed across all questions to arrive at a total score. Therefore, a small score on the TKIM is better; it indicates more agreement between the test-taker and the experts. The Raven Advanced Progressive Matrices test was scored by computing the total number a participant answered correctly out of the 12 questions on the test. As with all other measures of g, a high score is indicative of greater levels of the construct.

Analyses

Three separate discriminant analyses were performed. For the analysis of Hypothesis 1 (i.e., participants utilize different cognitive processes when solving practical intelligence tasks than when solving traditional general intelligence tasks), the type of test (either the Raven Advanced Progressive Matrices or the TKIM) served as the dependent variable in a logistic regression analysis. For Hypothesis 2 (cognitive processes can be used to predict scores on the Raven Advanced Progressive Matrices and scores on the TKIM), the scores achieved on the Raven APM and the scores achieved on the TKIM served as the dependent variables in separate linear regression analyses. Predictors in all analyses were the percentages of each type of cognitive process used by each participant.

Three variations of the analyses were also performed. One was done in order to see what the result would be focusing only on the cognitive processes the participants

actually used without the effects of a “no reason given” category. For this analysis the no reason given category was removed from the data, and then the percentages were recalculated. This approach was done because the failure to use or verbalize a cognitive process may not be important. A second variation retained the no reason given category, but combined the “deductive” and “inductive” categories. These two processes were initially coded separately, because they are considered to be distinct processes by the majority of the field. Some researchers, however, consider differences between them to be trivial. A final analysis combined the previous two analyses. In this analysis, the no reason given category was omitted and the deductive and inductive categories were combined. Ideally the same pattern of results will be found across all analytical strategies.

Results

For all regression analyses, a tolerance analysis was computed. For each analysis, one predictor was dropped due to multicollinearity. Removal of these variables reduced the multicollinearity problem. It should be noted that the removal of a variable serves to attenuate the multiple correlation, making it more difficult to support the hypotheses.

The results of the present study show that there is indeed a difference between the cognitive processes used in g-loaded tests and those processes used in practical intelligence tests. Table 1 presents the average cognitive process frequency score achieved on each test. In the basic analysis that employed all variables, without excluding or combining any, 98.3% of the variance in test type could be accounted for by using cognitive processes as predictors ($F = 385.946$, $p < .05$). These results show that there is a very strong relationship between the type of test taken and the cognitive processes involved. The regression equation for this analysis is shown in Table 2.

Table 1

Average Cognitive Process Percent
within Each Test.

Cognitive Process	Test Type	
	Raven	TKIM
Experience	0	5
Number Facility	2	0
Rote Memory	0	2
No Response Given	10	16
Deductive Reasoning	2	45
Inductive Reasoning	53	0
Fluency	0	33
Spatial	16	0
Figural Addition/Subtract	16	0
Flexibility/Speed of Closure	0	0
Span Memory	0	0
Perceptual Speed	0	0
Verbal Comprehension	0	0
Verbal Closure	0	0
Visual Memory	0	0

Table 2

Summary of Multiple Regression Analysis for Variables PredictingTest Type When all Variables are Included (N = 61).

Variable	<u>B</u>	<u>SE B</u>	β
Fluency	1.217	.106	.431*
Number Facility	.203	.476	.009
No Logic	.594	.100	.137*
Rote Memory	1.325	.495	.053*
Spatial	.142	.178	.029
Addition/Subtraction	-.283	.203	-.053
Deductive Reasoning	1.019	.087	.492*
Experience	1.469	.232	.136*

Note. $R^2 = .983$. A tolerance analysis dropped Inductive Reasoning due to multicollinearity. The following variables were omitted from the analysis due to zero variance: Flexibility/Speed of Closure, Perceptual Speed, Verbal Comprehension, Verbal Closure, and Verbal Memory.

* $p < .05$.

Using the base set, test scores could not be predicted using cognitive processes as independent variables. Therefore, Hypothesis 2 was shown to be false: subjects who score high on either the TKIM or the Raven APM do not use different cognitive processes than those who score low ($F = 1.058$, $p > .05$ and $F = 1.245$, $p > .05$, respectively). These results suggest that although subjects may use different cognitive

processes on practical intelligence tests than they do on cognitive ability tests, this relationship is not affected by the score on the test. High and low scorers appear to use the same kinds of cognitive processes on each of the tests. Another reason that no differences were found with Hypothesis 2 has to do with power. With 30 or 31 subjects and six predictors, there was a 5-to-1 ratio of subjects to predictors. This ratio can result in low power and an inability to detect differences between the subjects.

The failure to prove Hypothesis 2 may also be due to the experts used in the TKIM scoring. Recall that the answer key for the TKIM was established using 27 expert managers at a manufacturing plant. True to the nature of the tenets of practical intelligence, the TKIM was largely developed to be used in each individual organization where the scoring key would be based on experts in that specific setting. In that manner, the tacit knowledge being tested is unique to what makes one successful in that environment. However, in this study organizationally specific experts were not used, and that may be seen as one explanation for why Hypothesis 2 was not supported. However, neither the Raven APM nor the TKIM showed significant results as regards Hypothesis 2. The scoring of the Raven APM is standard from environment to environment, yet no significant results were found with the Raven. Therefore, it is unlikely that the failure to find differences in the testing of Hypothesis 2 is due to the lack of organizationally specific experts used in scoring.

When looking at the cognitive processes participants actually used by removing no reason given from the analysis, it was found that 99.6% of the variance in test type could be accounted for ($F = 1836.272$, $p < .05$). The regression equation for this analysis is presented in Table 3. Combination of the deductive and inductive processes (as well as

the inclusion of the no reason given category) accounted for 93.9% of the variance in test type ($F = 117.270$, $p < .05$). This combination of the deductive and inductive processes resulted in decreased prediction. The regression equation can be found in Table 4.

Table 3

Summary of Multiple Regression Analysis for Variables Predicting

Test Type When No Reason Given is Excluded (N = 61).

Variable	<u>B</u>	<u>SE B</u>	β
Fluency	6.521	.055	.027
Inductive Reasoning	-1.035	.038	-.626*
Number Facility	-.889	.202	-.043*
Rote Memory	2.819	.190	.001
Spatial	-.899	.064	-.197*
Addition/Subtraction	-.943	.064	-.211*
Experience	3.547	.071	.005

Note. $R^2 = .996$. A tolerance analysis dropped Deductive Reasoning due to multicollinearity. The following variables were omitted from the analysis due to zero variance: Flexibility/Speed of Closure, Perceptual Speed, Verbal Comprehension, Verbal Closure, and Verbal Memory.

* $p < .05$.

Table 4

Summary of Multiple Regression Analysis for Variables Predicting
Test Type When Deductive and Inductive are Combined (N = 61).

Variable	<u>B</u>	<u>SE B</u>	β
Number Facility	-2.823	.824	-.126*
Rote Memory	-.430	.978	-.017
Spatial	-2.317	.231	-.474*
Addition/Subtraction	-2.905	.239	-.545*
Experience	-.332	.475	-.031
No Logic	-1.148	.232	-.264*
Logic (Deductive + Inductive)	-1.179	.201	-.337*

Note. $R^2 = .939$. A tolerance analysis dropped Fluency due to multicollinearity. The following variables were omitted from the analysis due to zero variance: Flexibility/Speed of Closure, Perceptual Speed, Verbal Comprehension, Verbal Closure, and Verbal Memory. A tolerance analysis dropped due to multicollinearity.

* $p < .05$.

Finally, both the removal of the no reason given category and combination of the deductive and inductive categories resulted in 93.7% of the variance accounted for ($F = 134.380$, $p < .05$). The regression equation for this analysis can be found in Table 5. Given that all four analyses of Hypothesis 1 resulted in a significant and strong R^2 (i.e., all were greater than 90%), Hypothesis 1 is supported. In other words, subjects do use different

cognitive processes when solving practical intelligence tasks than when solving traditional cognitive ability tasks.

Table 5

Summary of Multiple Regression Analysis for Variables Predicting
Test Type When Deductive and Inductive are Combined and No
Reason Given is Removed (N = 61)

Variable	<u>B</u>	<u>SE B</u>	β
Number Facility	-2.728	.748	-.133*
Rote Memory	-.566	.777	-.029
Spatial	-2.260	.201	-.497*
Addition/Subtraction	-2.301	.194	-.514*
Experience	-.455	.303	-.064
Logic (Deductive + Inductive)	-.997	.166	-.249*

Note. $R^2 = .937$. A tolerance analysis dropped Fluency due to multicollinearity. The following variables were left out of the analysis due to zero variance: Flexibility/Speed of Closure, Perceptual Speed, Verbal Comprehension, Verbal Closure, and Verbal Memory.

* $p < .05$.

Analyses of test scores by demographic variables did not reveal significant differences. When examining the Raven and TKIM scores, men did not score differently from women ($t = 1.255$), graduate students did not score differently from undergraduate students ($t = -1.577$), and traditional students did not score differently from non-

traditional students ($t = -.291$). Similarly, those undergraduate students who indicated they would pursue an MBA did not score differently from those who did not have those plans ($t = .776$). Table 6 shows the mean Raven and TKIM scores achieved by each demographic group.

Table 6

Average Raven and TKIM Scores Achieved by Each DemographicGroup

Test Type			
Demographic Group		Raven (N = 30)	TKIM (N = 31)
Gender			
Male	<u>M</u>	8.67	51.26984
	<u>SD</u>	2.79	9.79989
Female	<u>M</u>	9.31	47.15046
	<u>SD</u>	1.32	7.90784
Student Classification			
Graduate	<u>M</u>	9.00	46.13272
	<u>SD</u>	2.12	7.49659
Undergraduate	<u>M</u>	8.95	51.03292
	<u>SD</u>	2.32	9.46241
Undergraduates Pursuing MBA			
Yes	<u>M</u>	7.89	52.07408
	<u>SD</u>	2.76	11.21248
No	<u>M</u>	9.42	48.55555
	<u>SD</u>	1.73	5.40512
Traditional/Nontraditional Student			
Traditional	<u>M</u>	9.40	48.60879
	<u>SD</u>	1.57	7.16833

Nontraditional	<u>M</u>	7.88	49.60318
	<u>SD</u>	3.23	10.86650

*All analyses were non-significant ($p > .05$). Note: Higher Raven scores indicate high general intelligence; lower TKIM scores indicate high practical intelligence.

Discussion

These results indicate there is a strong relationship between the test type and cognitive processes involved in answering test questions. The results of this study support the premise that the two tests are actually tapping into different cognitive processes. In short, g and practical intelligence are not redundant constructs. Some examples serve to highlight the differences. Participants who took the Raven APM tended to rely more on the inductive reasoning cognitive process more often than TKIM test takers did. Recall that in inductive reasoning, data is supplied and an individual must come up with the rules or principles that govern that data. Similarly, with the Raven APM, the individual is given certain “facts” or steps and must then apply rules or generate rules in order to find a solution. Conversely, participants who took the TKIM tended to use deductive reasoning more frequently than did those who took the Raven APM. With deductive reasoning, the participant uses “rules” or premises that are stated in an attempt to come up with the correct answer. With the TKIM, the test taker is supplied with a situation and must arrive at the conclusion by excluding unacceptable options. The rules are specified for the participant, and he or she must judge the desirability of the rules.

It was also found that individuals who took the Raven APM tended to use the spatial orientation and figural addition/subtraction processes more than their TKIM counterparts, although to a lesser degree than they used the inductive reasoning. This finding, again, is due to the nature of this particular test. Participants are presented with

figures and must often combine, eliminate or manipulate figures and patterns in order to come up with the solution.

Participants in the TKIM test condition also tended to use the fluency process more often than did individuals in the Raven APM condition. Individuals were given a fluency code when they came up with examples as they thought through a problem. This verbalization never occurred when participants solved problems on the Raven APM. Participants who took the Raven APM never simply stated examples as they solved each problem. Instead, they would reason through the problem by making and testing rules, or by utilizing mathematical concepts such as addition, subtraction or counting. See Appendix E for the average cognitive process score achieved on each test.

Recall that studies have shown that practical intelligence can predict accomplishments and achievements in a managerial setting (Wagner and Sternberg, 1985). The findings in the present study underscore Sternberg's assertion that practical intelligence may be the best predictor of job performance. Traditional intelligence tests may not be as effective in predicting future success on the job because they do not tap into the same cognitive abilities as practical intelligence tests do. Because this study shows that the TKIM measures a different aspect of intelligence than that measured by traditional, g-loaded intelligence tests, it is important to use practical intelligence tests when forecasting an individual's future job performance.

It has been shown that the principles of practical intelligence can be taught and can produce improvements in achievement and performance (Sternberg, 1998a, 1998b; Sternberg, Okagaki, & Jackson, 1990; Sternberg, Torff, & Grigorenko, 1998). The

present study may facilitate this kind of training by identifying the types of cognitive processes that tend to be used when performing practical intelligence tasks.

The results of this study point to even more potential benefits for Industrial/Organizational psychology. It has been widely shown that many traditional intelligence tests characteristically show disparate impact against many racial groups (Herrnstein & Murray, 1994). Future research needs to be done to discover if the same racial disparities are present on the TKIM test. If not, Industrial/Organizational psychologists have a test that has been shown to be highly predictive of job performance yet does not suffer the downfall of disparate impact. Thus, the TKIM may prove to be a valid, non-biased intelligence test available for use in selection.

There are some possible limitations to the present study. The sample size was small by any standard. Future research should be conducted with larger samples to gain a better understanding of the true effects of the study. Also, the use of students as participants in the study may have limited the effects, due largely to the fact that the TKIM tests knowledge that is deemed useful for success in the workplace. Thus, using students rather than employees of an organization may have affected the results gained from the TKIM. Future research should be conducted with individuals in the workplace, in order to see how findings may be affected. It is unlikely that the results will differ from those in the present study, because many of the individuals that participated in this study were graduate students who either were working presently or had worked and decided to return to school to pursue their MBA.

Another possible limitation of this study may come from the verbal protocols used in gathering the data. As was mentioned previously, two subjects' data had to be

eliminated from the study due to their unwillingness or inability to verbally record their thoughts as they took the test. It was discovered during the coding of the protocols that some subjects were able to very effectively and generously verbalize their thought processes as they solved each problem, whereas other subjects were more brief and less verbose when attempting to describe how they answered the test problems. Also, the no response given code was used several times because subjects would merely rephrase the question or describe the picture, instead of offering any true insight into the thought processes they used to solve the problem. Whether due to a misunderstanding of the instructions they were given, or to their inability or reluctance to respond verbally, is uncertain. Either of these factors this may have limited the results of the study. However, it must be pointed out that this limitation would have affected both tests equally; therefore it is unlikely that it affected the results.

In sum, this study revealed that traditional intelligence tests tap into different cognitive processes than do practical intelligence tests. This finding is significant since it settles the debate of whether practical intelligence is just another form of general intelligence. Future research should be directed toward how to best use this information to facilitate better personnel decisions in the workplace.

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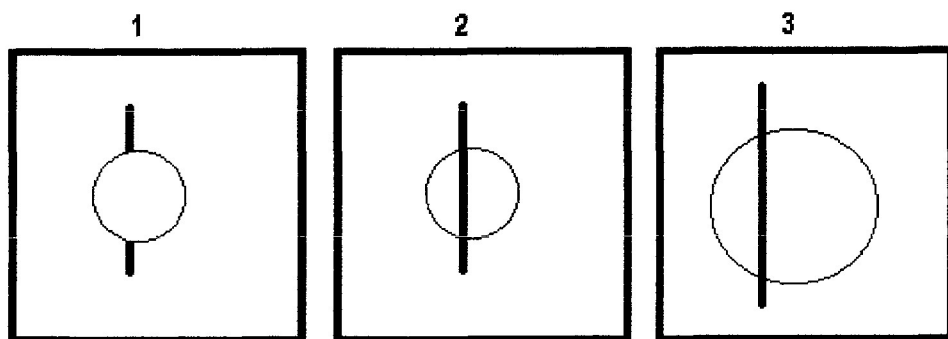
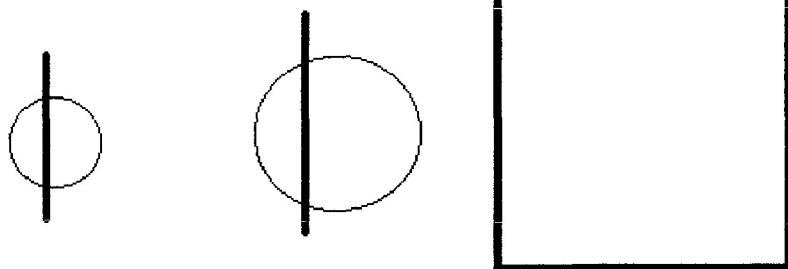
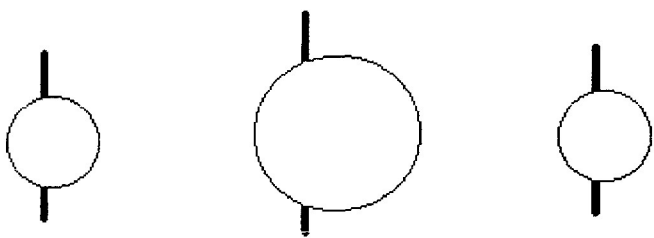
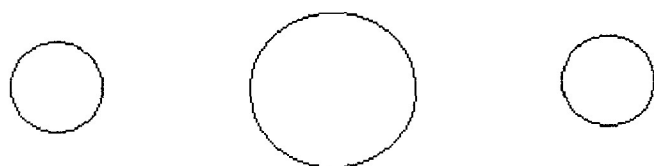
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APPENDIX A

Sample Raven Advanced Progressive Matrices Test

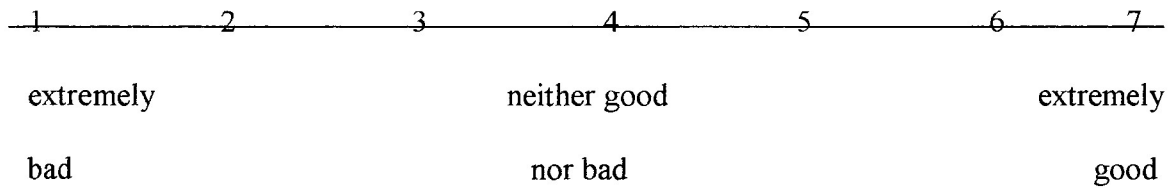


APPENDIX B

Sample Tacit Knowledge Inventory for Managers Test

You are a new manager who is trying to learn the corporate culture in company XYZ.

Rate each of the following options by their usefulness to your quest for knowledge of the culture:



1. Read the company's employee manual.
2. Identify a popular employee and observe their actions in company meetings.
3. Ask your manager for advice.
4. Have a coworkers complete a survey about you detailing your strenghts and weaknesses.
5. Pose for the company's swimsuit calendar "Men of Company XYZ".
6. Hang around the restroom soliciting advice from visitors.

APPENDIX C

Example of a Coded Raven Advanced Progressive Matrices Test

1. “We got some lines, some shapes; background – the dashed lines are in a sequence of going across they are all similar to this one line, 2 lines going across the middle, 3 lines going across the bottom, so therefore the bottom one needs 3 additional lines, meaning this could be #1,5,7,or 4. Shapes: each column we got a square, a diamond and a circle so the last column is missing the diamond so the last one should have a diamond with 3 dashed lines, which would be #5.” This received a code for Inductive Reasoning.
4. “This one’s a little bit different; it appears that going across on the 1st row that we’re taking away a leg of the object aside, and in the 2nd row that appears to be the same case, and the as in the 1st row they’re pulling off the left side 1st and then the right, and in the bottom row again they’re pulling off the left again so they’re probably going to be pulling off the right again, so preliminarily that would give you a square inside of a square, so #4 would fit that pattern across. Going down, it looks like you’re pulling off the top and then the bottom, so #4 would be the correct one: the square in the square.” This received a code for Inductive Reasoning and a code for Spatial Orientation and Visualization.
8. “Once again more shapes, let’s see...consistently wise they’re all pluses [inside the answers]. In the 1st one the foreground shape the box on top, going across there doesn’t appear to be any sort of consistency, the only consistency is going across, tends to be you gotta a white square, a black square and a slashed square that appears to be consistent with the 2nd row so that would leave you with a foreground on the 3rd one you need something with a solid black foreground giving the option looks like #1&4. Background appears to be the same way you’re just changing the scheme or

whatever you want to call it; the background object is the same so that's going to leave you...with the background hashes, foreground solid...it's #1." This received a code for Inductive Reasoning.

11. "This one looks like it's going 2,1,3 across, 2,1,3 and the other one would be 2,1,3 wierdlike so preliminary guess it would have to be a 3 x 3 grid so either #5,3 or 7. Going down you got 2,1,3; 2,1,3; 2,1,3 that doesn't really help anything so we still know we need a 3 x 3, let's start looking at the patterns on the inside. It appears going down on the 1st and 2nd the end one is a combination of the 1st and 2nd so to get the same combination in the last column you got option #5." This received a code for Inductive Reasoning and a code for Figural Addition/Subtraction.
15. "All shapes and stuff...going down you got vertical and horizontal and a combination of these lines, going down you got slash to the left and slash to the right, combination and you got wavy ones going one way and wavy ones going the other so the combination wavy background is going to be the background to this one, that leaves you #1,2,3,4,7 as options. Let's look at the foreground shapes. Going across you got a carrot up and a carrot down making a diamond; a smile and an upside down smile making a circle, you got ½ a square and another ½ square so you need a square in the foreground, a square in the foreground and the combination background gives you #2." This received a code for Inductive Reasoning and a code for Figural Addition/Subtraction.
18. "This one appears to be different due to the fact that there is no foreground or background, so we'll have to look at this one a little differently. Don't see anything consistent going down exactly, nothin's jumping out at me going across, primary

judgement – I have no idea. Let's see, where's the pattern. All right. If we go down in the 1st column you got a square, so sort of weird plus thing that is kind of elongated on one side then you got a rectangle the same dimensions it's the elongated thing but in the shape of the 1st square. The middle one you got a smile, you then got a slash, and then you got a smile at the end of a slash. In the 3rd one, you got a concaving square, you got a plus thing at an angle so that would give you a concaving something at an angle would be my guess. So we're looking at #7 as being appropriate going down. Going across, you got a square, a smile and then a square with a bunch of smiles on it concaving in. Across the 2nd row you got a plus, a slash, and then a plus at the end of slash. The 3rd row you got the rectangle, the smile at an angle, which would mean you got a rectangle at an angle concaving in, so we're still at #7." This received a No Response Given Code.

21. "You got in the 1st column a bunch of dots in the background; this seems somewhat consistent going down. The 2nd row you got the consistency of lines being in all 3. In the 3rd row I'd say the consistency is going to be black. Going across consistency wise you got dots in the middle of all 3 objects. In the 2nd row you got lines in the middle of all 3 objects. 3rd row you got black in the middle of all 3 objects. So it looks like you'll have to have black in the middle of whatever objects you put in the box. That would leave you with #7. Further evaluation...trying to see what the consistency of the shapes is going down. Obviously the 1st column is squares, the 2nd one is triangles, the 3rd is double triangles. That would lead you to believe that the empty square would have to have something with double triangles at some angle, which would leave you with #1,4,8 but none seem to fit the pattern of having the black

going straight down the middle. #1 would if you flipped it 90 degrees. Definitely the pattern going across the bottom row is a black solid in explaining the outer shape.

Let's go back to the one across. Across the consistency is the same color in the middle and the same pattern, dots on the top, slashes, and solid black. Need to look outside. Outside patterns do not have the same thing going across. You got dot slash dark, dot slash dark, dot slash dark. It appears that #8 is the answer with the dot slash dark going across. That would be the outside getting dark. Yeah that's it b/c the topmost square in the corner has the same all the way through the entire thing." This received a code for Inductive Reasoning.

23. "Starting to get a lot of patterns in these shapes. It looks like the outer image got projected inside the inner image but that doesn't make any sense. Going down... no let's go across, the 1st row across. It looks like it's going diamond pattern on the inside. Exterior lines, the box, is getting replaced by dots, putting boxes back. Box is disappearing, cross is disappearing... I was going to say the interior shape disappears by the 3rd frame, but that doesn't appear to be the case either. Ok, we're going to take this on the reverse by looking at the answers 1st; go through the back door to see which one would be the answer. Preliminarily I'd say #5,6,2,3,8 would be the answer b/c they all have dots; there's more options with dots than w/o dots, so it'd lead me to believe it'd be one of those 5. That makes sense b/c the 2nd column and the 3rd column the consistency of dots and dots, a circle and a circle, and a dot and a dot. The 1st one is the consistency of the outer shape, the inner shape is diamond and the diamond, the diamond and the diamond still, and I don't know what it is on the last one. Let's go with the dots being consistent. What is the pattern...ok here's something jumping out

at me. In the 1st column, you got 3 shapes: the box, the X in the box and the diamond-diamond thing behind there. The 2nd box the X has gone into the diamond but you still have the box. The 3rd one you still have the X from the 1st and you also have the plus that's inside the diamond with the X jumped inside the diamond and the outer box has disappeared and the inner diamond has disappeared. Let's take something along those lines to the second column. You got 3 shapes: the diamond, the X and the dots. Going from the 1st to the 2nd one you got the circle, you got a diamond. In the 3rd one you got the dots back and you got the circle but the diamond's disappeared and you got the X. Whatever's disappearing in the 1st row and reappearing in the 3rd row is part of shape in the bottom box, so that proves the dots. Dots disappear, they have to reappear. So you got the dots being in there. What else is. Going down looking at the inside objects, trying to figure out what's gonna have to be inside those dots. I'm gonna eliminate option #5. What is the pattern...ok here's something that's now jumping out at me. Going across, you got diamonds, you got diamonds, you got nothing. Going across you got diamonds, you got diamonds, you got nothing...well you got a circle. Going across you got a X, you're not gonna have an X that eliminates #5. That brings us back to #2,6,3&8. It appears that the object that jumps in at the 2nd column that remains in the 3rd is there continuously. For instance, the dots jump in, dots jump in across the 1st one. The 2nd one a circle jumps in, the circle's in the other one. The 3rd one dots jump in, dots jump in, or is it the circle that's jumping in. 1st one, box disappears, box comes back in; 2nd one, the thing that disappears is the cross piece across the center, it comes back. 3rd one – the thing that disappears is the cross piece up and down, meaning it would reappear. If it has to be a cross piece

reappearing it has to be #3 or 6 b/c those have the dots and the cross piece. What else. I gotta figure out if there is a circle or not. I'm wanting to say 6, I'm not sure why though. I can't justify it. Let's see... what is the pattern. Let's go back to going down. You got box, box, no box; 3rd column box, box, you eliminate the box. Also got a cross piece going down. I'm getting tired with this one, I'm going to go with #6 being the answer; it seems to meet all the criteria." This received a code for Inductive Reasoning and a code for Spatial Orientation and Visualization.

25. "Going across you got nothing, $\frac{1}{2}$ & $\frac{1}{2}$, full; nothing, $\frac{1}{2}$ & $\frac{1}{2}$, full. Background is gonna have slashes fully; definitely going to eliminate #5. Going down: nothing, circle, circle; square, circle, circle; circle, circle – you're going to have to have a circle inside a square. Well they all do, that doesn't do a damn bit of good. Going down the middle, you have circles... all right, if you look at the center square tile, the circle has all 4 characteristics of a pie piece. Let's see... if you divide the circle into 4ths, going down, the top corner of the circle never changes as to the background. The top corner of the circle is going to have to be shaded. The answer may be #4 maybe. Circle on the bottom is always consistent; the bottom corner is always dotted or black. That doesn't make sense; it's gotta be consistent so it has to be black. I'm going with #7, I believe that would be right. The circles appearing inside, you gotta take the left corner, it goes dot, dot, black; diagonal goes white, white, it would have to be slashed in the left corner. Right top corner described goes across, slash, slash, slash; dot, black, black; 7 is the answer." This received a code for Inductive Reasoning.

30. “Too many shapes inside; make me think too much! We got...down the outermost squares slash, slash, dark; middle square dot, slash, empty; slash, dot, empty. Dark, slash, dot; dark, vertical and vertical, white, dot and horizontal. Horizontal, dot, vertical; blank, blank, black. Vertical, horizontal...let’s see. I’m not finding any patterns so far. Let’s look down across again. All right, look’s like we got 3 squares no matter what. Easy enough. Your options of lines are vertical, horizontal, dot, black, or white. 1st one has 3 options all different; 2nd one has 2 options, none corresponding with the 1st one and 2 that seem the same; 3rd one has 3 separate options; next you have 3 options all different; then you have 3 options all the same as #1; then you have 2 options, none being the same; next one you got 2 options none being the same; 3 options different, 3 options different. It looks like going across black and white only appear once, and black and white never appear with any of the other patterns, so anything with black and white is eliminated from our options. That eliminates 1, 4, 7 & 6, leaving us with 2, 3, 5, 8. All right. Knowing it’s not black or white you gotta find a pattern. It appears going down comparing just the 2 squares, you got vertical lines similar, 2nd one you got vertical lines similar, 3rd one you would have maybe vertical lines similar in the center. If so, that would leave 5 & 8 as options. Let’s see, try to find the other pattern. Dot over here, dot in the center, dot outside, dot inside, dot there. Let’s see you got dots in 1 & 2, 3; dots in the outside maybe; that would still leave 5 & 8. It looks like 5 is the magical number.” This received a code for Inductive Reasoning.
31. “You got 3 sections in all 3. Going down appears you got...let’s see, describing the types you got horizontal stripes, solid white, slashes, and vertical stripes. Those

appear to be the only 4 combinations possible, and no square does any combination appear to be more than once. If that happens, #1 is eliminated. If you're going down, you got vertical white slash, then you got horizontal white slash, slash white vertical. So whatever's in the 1st 2 are going to be in the last 2. Horizontal stripes will not be in the final answer. That eliminates 2,3,5,6,7. I'll be lucky if that's right. We'll see. No, if you go down the middle column 2 things are similar there. Let's go across. 1 is still the only one that is eliminated. Going across, the only consistently is the slashes, all 3, the top row and the middle row; the only one consistent to all 3 is the slash again. Back in the same square, across the bottom row consistent would be the slash again by that philosophy. The slash would have to be in the 1st rectangle of the cell. That leaves you option 7 & 8. Let's go with that temporarily, and going down, slashes are never in the same one. Let's see what else you got. Going down, 2 of the 3 squares always have white, always in the same column. That would mean white would have to be in the final which eliminates all but the one I want. Um, going down you never appear to have more than 2 vertical stripes or 2 horizontal stripes. By that standard you wouldn't have any horizontal, you would have to have a vertical in the same column. This leaves you with 6, 7, & 8. Let's see...you never begin the same, so I'm confident in #1 being eliminated. 8 of the 9 squares all have the slashes, never in the same cell horizontally; if you go across, they're never in the same cell vertically. That means the slashes have got to be in the last rectangle. The last rectangle...going with that you know it's 2, 3, 4, 5 or 6; it has to have a white square, because that's in 2 of them, 2 of them. #4 is the answer, because you need 1 more vertical stripe that's not in the column." This received a code for Inductive Reasoning.

35. "You got the peace signs going crazy. All right... 1st one going down, you got a dash, a dash, 2 dashes; a dash, a dash, 2 dashes; 2 dashes, 2 dashes, blank. Opposite that you got 2 solid lines; you know a circle is in the background – that's in all of the answers. If you look at the answers, you got these pluses that appear, which I don't preliminarily think that would be part of it, 'cause those don't really appear in the 1st one. So looking across, 1st row, solid line always to the north; 2nd row, solid line always to the south; 3rd row, no consistency. 1st row, 2 solid lines, 2 solid lines, 1 solid line... all right let's look at the whole shape as a whole. You got 'em pointing southeast, southwest and north. You got northeast, northwest, and south. You got east, you got west, you got east, you got, hmmm. The top row northwest items all line up with each other. Let's see...you got 3 pieces, 1 dash, 2 lines; 1 dash, 2 lines; 1 line, 2 dashes; 2 lines, 1 dash; 2 lines, 1 dash; 2 dashes, 1 line; 1 line, 2 dash. I'm now going through the answers, just looking at ones as options, seeing why one might jump out at me; I'm not finding any jumping out at me. 1's already matched by the center one; nothing leads me to believe that you'd go from having the whole solid, I don't know why; nothing jumps out at me at #3 for breaking into an X; #4 no reason to have a solid dashed Y; #5 no reason to have an X; 6 why a solid dashed Y; 7 is going crazy with all sorts of stuff in there which I don't really understand; 8 being the plus sign inside of it; none of these options appear to be the right option. Maybe I'm not focusing on the way the thing bisects it. You have 3 pieces of pie...the pie in the corner to the quadrant 4, corner in quadrant 1, the corner in between 2 & 3; corner in quadrant 3, corner in quadrant 4, corner between 1 & 2; corner in quadrant 2...preliminarily, well maybe not so much preliminarily anymore, the only shape

that's consistent on the inside, meaning that it either has some dashes is #1 with the Y sign; all the rest have gone and starting pulling things out of somewhere. You gotta line, you got an angle and a circle. I'm thinking it's gonna, I don't know, I'm thinking 1 because that's the only one that's consistent with the other patterns, you know, being the same shape and whatnot, but I don't see why it fits in, except for that reason, so I don't know if it's a trick question or something or what. Um, I'm going to go ahead and put #1, partially because I'm getting tired of looking at these things 'cause they're making me cross-eyed, and partially because none of the others seem to meet that pattern." This received a code for Inductive Reasoning.

APPENDIX D

Example of a Coded Tacit Knowledge Inventory for Managers Test

1. "That is probably neither extremely bad nor good; more bad than anything. I'd say that's at least a 2. If you take a leave of absence of your job you're missing out on a lot of developments in that market while you're gone, no matter how hard you try to stay in touch with it; if you're gone from a market for how ever many years it takes to get an advance degree, you lose out." This received a code for Fluency.
2. "That's probably a good idea, I think any information you can get in your relevant field can only help you; I'd be cautious of the source of who puts it out." This received a code for Fluency.
3. "I'd say that's an extremely good idea; I think he should have already been doing that, I'll say that's a 7." This received a code for No Reason Given.
4. "That is also an extremely good idea, I'm surprised he hasn't already been doing that. No wonder he's out of touch with his market and losing market share if he doesn't know what the consumers in that market are doing." This received a code for Fluency.
5. "Again that is an extremely good idea. I'm surprised he's not already doing that. It's starting to become apparent to me why this guy is losing market share." This received a code for No Reason Given.
6. "I think that's probably neither good nor bad. The R&D group is typically as I understand it, a group that works 3-4 years out and that's long-term goals more involved there with where you want to go in the marketplace rather than your immediate problem of why you're losing market share. Of course if your R&D group is no good, than maybe coming to the weekly meetings will bring that out." This received a code for Deductive Reasoning.

7. "I think that's uh, I'll give that a #5. That's a good idea. Um, I'm always weary of outside research scientists coming to my company to give me their take on something; they're usually following it right up with a sales pitch/" This received a code for Personal Experience.
8. "That's a terrible idea. Never count on anybody to tell you what you need to know. You need to be able to figure that out for yourself." This received a code for Fluency.
9. "I think that's probably, I'll give that a 3. More paperwork to read, never get you anywhere." This received a code for Fluency.
10. "Uh, I think that's probably, I'll give that a 3 also. By doing that you're asking those people to take time away from developing new products to put together these little issues or presentations. That's time they can be spending developing new stuff." This received a code for Deductive Reasoning.
21. "Uh, I'm not quite sure about this little story, I'm not quite sure what this guy hopes to prove. Is he going to try to convince this manager that he has in fact done a good job, or is this just going to be some on-going rhetoric between the 2 of them that's just going to lead to arguments? So I'm going to take the approach that this is going to be a rational discussion and this guy is going to try to explain to the manager why he did what he did, and assume that this is not going to be an argumentative type-thing. I'm going to say that this would probably be neither good nor bad, um, that's a pretty level statement; I don't think he's going to rile anyone up with that. At the same time it states a mild degree of culpability but tempers it with the fact that he did indeed meet the budget and the deadline, which is what he thought was important." This received a code for Fluency.

22. "That would be an extremely bad idea; that is opening the door uh for argument by stating that you're almost surely baiting the other guy into more and more critical statements." This received a code for Fluency.
23. "I think that is also an extremely bad idea. That is in my opinion rolling over and playing dead. Um, I think that I would probably not do that." This received a code for No Reason Given.
24. "I think that is an extremely good idea. It could be that this guy has an ax to grind for something completely separate from this project." This received a code for No Reason Given.
25. "That's something that is always a possibility for everyone." This received a code for No Reason Given.
26. "You get to ask your boss for his advice, which everyone likes to have their advice asked for. It also opens the door for him to give you those examples and if he cannot, you can tell right away whether he's just being petty or overly critical." This received a code for Fluency.
27. "Yeah, by asking for a second chance, you tell the other person you are open to constructive criticism and at the same time, do not close the doors to any further opportunities that you may or may not get." This received a code for Deductive Reasoning.
28. "Depending on the tone in which that is asked, it could be taken quite sarcastically. If it can be pulled off sincerely, it's probably a good idea. If not, it's a bad idea." This received a code for No Reason Given.

29. "If it is indeed someone you trust, it'd probably be ok; otherwise, uh, in my opinion that would be kinda of what we would call a crybaby or a whiner." This received a code for No Reason Given.
30. "Point out the obstacles that you had to overcome and admit some culpability to maybe having mishandled a few people in the way of getting that done." This received a code for Fluency.
31. "Just because you work long at something doesn't mean you get anything done and in the professional world it all comes down to what do you get done, not how long it took you to do it." This received a code for Fluency.
32. "It works well for some people, for some it doesn't. it doesn't work for me but I know some people that it does work for." This received a code for No Reason Given.
33. "I think that if you stop to reward yourself everytime you get something done, and if you're any good at all, all you'll be doing all day is rewarding yourself for finishing all your tasks." This received a code for Deductive Reasoning.
34. "You cannot be in control of everything at all times. You're fooling yourself if you think you can and you're only going to frustrate those working around you. Trust me, I know; that's what my boss does." This received a code for Personal Experience.
35. "You do need to occasionally get a change of scenery and get a break in the monotony. Otherwise the work does become unenjoyable." This received a code for Fluency.
36. "If you delegate only inconsequential tasks, then the people that work for you will quickly catch on to the fact that you're only asking them to do things that are small and worthless, and you will typically find that you get what you expect. If you expect

people to do things correct and quickly, that's what you'll get by and large." This received a code for Deductive Reasoning.

37. "Uh, by the same token, if you only do what you're in the mood to, then that's what you'll get done. And unfortunately life is full of things that aren't very pleasant, and also unfortunately you have to get those things done along with the pleasant things, or you quickly develop the reputation of being a loser." This received a code for Deductive Reasoning.
38. "By soliciting too much feedback too early on, you get too many people giving you input and that muddies the water or only confuses the issues from time to time." This received a code for Fluency.
39. "If you're setting your own deadlines ahead of the external deadlines, you quickly find out that the world does not operate on your schedule, but you have to operate on the schedule that is imposed upon you by customers, etc., etc." This received a code for Personal Experience.
40. "I think you do need to spend time planning on a good way to do something, but you need not spend an inordinate amount of time planning to do something the best way because you'll find that all the time you've spent planning to come up with this best solution could have been spent by getting underway and maybe revising a good solution to be a best solution once you get started." This received a code for Fluency.
41. "Many people do just that and they will skim the highlights and if they cannot glean the basics of your report from the highlights, than your report will be reviewed as wordy and verbose." This received a code for Fluency.

42. "It's a good idea to lay the groundwork early on so some people can skip to different parts of the report if they need different information." This received a code for Fluency.
43. "In the business world, each business has it's own jargon, and I think in order to communicate quickly and without excess words some jargon is occasionally called for. Uh, not a whole lot, but just enough to get the job done. So some may be necessary." This received a code for No Reason Given.
44. "It's best just to get to the point, convey your message without uh, being a wordsmith. You're not out to impress people with how many words you know." This received a code for No Reason Given.
45. "A memo to the CEO will be differently worded than a memo to a fellow chemist or psychologist." This received a code for No Reason Given.
46. "You should write carefully the first time around, um, but that does not necessarily mean that you will not have to re-write. Writing carefully the first time around just means that you are trying to minimize the mistakes that you have to correct on the 2nd check, the 2nd rewrite." This received a code for Fluency.
47. "You never know when that memo is going to be passed around to someone higher up, so it's best to have your style formal rather than informal." This received a code for Fluency.
48. "Sometimes the best way to get across a message is to use a visual aid. Many times when you're discussing business trends, such as sales, expenses, etc., etc., trends can best be seen with charts that have upward or downward sloping lines." This received a code for Fluency.

49. "Once again, do consider your audience and the fact that your memo could be passed along to other people that may or may not be as familiar with your subject or topic."

This received a code for No Reason Given.

50. "That one's a tricky one. I've seen cases or been in cases where uh, the memo that you are writing or the business writing that you are doing does involve your expertise or opinion as a course of action, and therefore the "I recommend" line would be acceptable, in my opinion. But "it is recommended" would probably work almost as well." This received a code for Personal Experience.

APPENDIX E

Graph of Average Cognitive Process Frequency Score on Each Test

Average Cognitive Process Frequency Score Acheived on Each Test

